

AUTHOR INDEX

- Aalbersberg, I.H., 238
 Alpern, B., 116
 America, P., 227
 André, F., 214
 Apt, K.R., 50
 Astesiano, E., 162
 Autant, C., 13, 37, 239
 Back, R.J.R., 50, 67, 136, 170
 Baeten, J.C.M., 1, 67, 227
 Bauer, F.L., 16, 170, 173
 Becker, B., 44, 228
 Bednarczyk, M., 77, 238
 Belmesk, Z., 13, 37, 239
 Bergstra, J.A., 1, 13, 20, 67, 127, 237,
 240
 Berthelot, G., 40, 240
 Best, E., 12, 26, 49
 Bjørner, D., 228
 Bradfield, J., 99
 Bretschneider, M., 227
 Brookes, S.D., 1, 13, 15, 44, 47, 50, 124,
 166
 Broy, M., 16, 33, 170, 237
 Burstall, R.M., 225
 Campbell, R.H., 43, 49
 Chandy, K.M., 1, 14, 98, 227
 Chaochen, Z., 1, 14, 98
 Clarke, E.M., 17, 98, 170, 240
 Czaja, L., 49
 Damm, W., 227
 Darlington, J., 225
 DeCindio, F., 49
 DeMichelis, G., 49
 DeNicola, R., 13, 14, 15, 50, 51, 67, 70,
 71, 72, 73, 76, 77, 118, 124, 127,
 166, 240
 Degano, P., 13, 33, 50, 51, 70, 71, 72,
 73, 76, 77
 Dijkstra, E.W., 14, 16, 43, 98, 170, 171
 Duque Antòn, M., 227
 Döhmen, G., 227
 Emerson, E.A., 17, 98, 170, 240
 Fernandez, C., 12, 26
 Fink, A., 227
 Francez, N., 15, 124, 237
 Genrich, H., 40
 Goltz, U., 26, 49, 50, 67, 71, 72, 90
 Graf, S., 99
 Gries, D., 14, 98, 179
 Gunter, C.A., 136
 Habermann, A.N., 43
 Harel, D., 20
 Hehner, E.C.R., 16, 170
 Hennessy, M., 13, 14, 15, 50, 67, 99,
 118, 124, 127, 160, 162, 166,
 227, 237, 239, 240
 Herman, D., 214
 Hoare, C.A.R., 1, 2, 13, 14, 15, 16, 20,
 43, 44, 47, 50, 74, 97, 98, 124,
 127, 140, 143, 146, 150, 166,

- 170, 185, 204, 227, 228, 239
Hopcroft, J.E., 24, 112, 197, 221
Hotz, G., 44, 228
INMOS Ltd., 227, 228, 239
Ingólfssdóttir, A., 239
Jensen, K.M., 228
Jonsson, B., 98, 179
Keller, R.M., 19, 20
Kleene, S.C., 138
Klop, J.W., 1, 13, 20, 67, 127, 237, 240
Kluge, W., 227
Knuth, D.E., 118
Kok, J.N., 227
Kolla, R., 44, 228
König, D., 118
Lamport, L., 98, 116
Lauer, P.E., 13, 43, 49
Lehmann, D., 15, 124
Loeckx, J., 136, 235
Manna, Z., 17, 98, 170, 225, 240
Mayr, E.W., 65
Mazurkiewicz, A., 97, 238
Meyer, A.R., 162
Meyer, J.-J.Ch., 50, 143
Milner, R., 1, 13, 15, 16, 20, 21, 43, 46,
47, 50, 62, 67, 74, 75, 99, 160,
162, 208, 212, 214, 239
Minsky, M.L., 65
Misra, J., 1, 14, 98, 227
Molitor, P., 44, 228
Montanari, U., 13, 33, 50, 51, 70, 71,
72, 73, 76, 77
Morgan, C., 170
Mosses, P.D., 136
Mycroft, A., 49, 50, 71, 72, 90
Nielsen, M., 19
Nivat, M., 46
Olderog, E.-R., 13, 14, 15, 16, 47, 50,
70, 74, 98, 103, 115, 124, 127,
143, 146, 150, 170, 171, 215,
228, 237
Ossefort, M., 14, 98
Owicki, S., 98, 116
Park, D., 13, 23, 35, 44, 235
Parrow, J., 62, 237
Petri, C.A., 1, 12, 13, 19, 20, 32, 33
Plotkin, G.D., 13, 19, 50, 160, 162
Pnueli, A., 1, 15, 98, 123, 124
Pomello, L., 35, 49
Rabin, M.O., 19, 20
Reisig, W., 1, 12, 19, 20, 26, 31, 32, 33,
49, 240
Rem, M., 98
Rischel, H., 228
Robert, P., 214
Roscoe, A.W., 1, 13, 15, 44, 47, 50, 124,
166, 185, 186, 227
Rutten, J., 227
Rössig, S., 228, 239
Sanella, D.T., 162
Schenke, M., 228, 239
Schneider, F.B., 14, 98, 116, 179
Schnoebelen, P., 13, 37, 239
Scott, D.S., 15, 19, 20, 50, 136
Shields, M.W., 13, 43
Shoenfield, J.R., 112
Sieber, K., 136, 162, 235
Sifakis, J., 99
Simone, C., 49
Steffen, B., 99
Stirling, C., 99
Stoy, J.E., 15, 50, 136
Tarlecki, A., 162
Tarski, A., 138
Taubner, D., 49, 62, 66, 71, 239
Torrighiani, P.R., 13, 43
Ullman, J.D., 24, 112, 197, 221
Vaandrager, F.W., 35, 49, 50, 72, 90,
227
Verjus, J.-P., 214
Waldinger, R., 225
Weijland, P., 1
Widom, J., 14, 98, 179
Winkel, G., 19, 49, 50, 72, 73, 90, 239
Wirth, N., 16, 170, 171
Wolper, P., 17, 98, 170, 240
Zucker, J.I., 50, 143
Zwiers, J., 14, 16, 98, 99, 103, 108, 111,
175, 179, 220, 240
de Bakker, J.W., 15, 44, 50, 136, 143,

AUTHOR INDEX

255

224, 227

de Roever, W.P., 98, 99, 171

van Emde-Boas, P., 98

van Glabbeek, R.J., 35, 49, 50, 72, 90

van Wright, J., 67

van de Snepscheut, J.L.A., 98

von Wright, J., 170

SUBJECT INDEX

- abstraction, 39
 - full, 160
- access control, 214
- action, 20
 - external, 20
 - internal, 20
 - morphism, 44
- aliasing, 179
- alphabet, 20, 109
 - extended, 104
 - projection, 109
- approximation
 - of fixed points, 154
 - operational, 159
- asynchrony, 54, 74
- automaton, 20
 - abstract, 22
- bisimilarity
 - strong, 23, 36
- bisimulation
 - strong, 23, 36
- bottom value, 101
- CADIC, 44, 228
- case, 28
 - graph, 31
- causal
 - dependency, 32
 - net, 32
- CCS, 43
- choice operator
 - informal semantics, 47
 - interleaving semantics, 74
 - net semantics, 54, 89
 - readiness semantics, 141
 - rule, 177, 233
 - syntax, 45
- closure
 - acceptance, 126
 - chaotic, 126
 - operator, 126
 - prefix, 126
 - radiation, 126
 - unstability, 126
- coincidence
 - of expressions, 105
- communication, 20
 - alphabet, 20
 - channel, 20, 239
 - initial, 175
 - protocol, 236
 - sequence, 97
 - trace, 101
- completeness, 220
- compositionality, 39, 92, 139, 144
- concatenation, 99, 101
- concurrency, 27, 237
 - auto-, 180
 - principle, 70
- concurrent

SUBJECT INDEX

257

- computation, 32, 33
 - processes, 1
 - transitions, 29
- congruence
 - right, 221
- consequence rule, 233
- construction, 171
 - completeness, 221
- context, 160
 - free, 44
 - rule, 177, 232
 - sensitive, 46
- continuity, 137
- correctness, 115
- COSY, 43
- counter
 - k -bounded, 198
 - 1-bounded, 190
 - 2-bounded, 193
 - bounded, 121
 - machine, 65
 - unbounded, 61, 122, 200
- CSP, 43
- deadlock, 117
 - freedom, 117
 - informal semantics, 47
 - net semantics, 55, 89
 - readiness, 140
 - rule, 177, 233
 - syntax, 45
- decomposition, 51
- determinism
 - external, 119, 133
- divergence, 117
 - freedom, 117
 - informal semantics, 47
 - interleaving semantics, 74
 - net semantics, 54, 89
 - readiness semantics, 140
 - syntax, 45
- embedding, 33
- environment, 102, 138
 - technique, 139
- equivalence
 - failure, 167
 - model, 161
 - modified readiness, 167
 - strong testing, 167
 - theorem, 159
- event structure, 19, 73
- expansion
 - equation, 222
 - rule, 179, 234
 - strategy, 197, 221
- expression, 100
 - communication, 100
 - logical, 100
 - natural number, 100
 - regular, 112
 - trace, 100
- expressiveness, 111
- extensibility, 126
- fairness, 236
- FIFO, 214
- fixed point, 137
 - approximation, 154
 - induction, 235
 - least, 137
 - technique, 139
 - theorem, 138
- flow relation, 32
 - well-founded, 32
- full abstraction, 160
 - theorem, 162
- Greibach condition, 46
- hiding operator
 - readiness semantics, 142
 - rule, 178, 233
 - syntax, 45
- history
 - of communications, 97
 - variable, 110
- identifier, 44
 - bound, 46
 - free, 46
- independence relation, 238

- interface, 114
- interleaving, 25, 75
 - case graph, 31
- isomorphic
 - weakly, 22, 30
- isomorphism
 - weakly, 22, 30
- König's lemma, 118
- Kleene star, 113
- language, 113
 - regular, 221
- length
 - of a trace, 99
- lifting, 35
- limit
 - of a chain, 137
- liveness, 116, 230
- marking, 28
 - initial, 26
 - reachable, 29
 - stable, 116
 - strongly well-formed, 78
 - well-formed, 58
- may relation, 117
- mixed term, 172
 - closed, 172
- modal logic, 99
- modularity, 197, 212
- monotonicity
 - of mappings, 136
 - of specifications, 230
- morphism
 - informal semantics, 47
 - interleaving semantics, 74
 - net semantics, 54, 90
 - syntax, 45
- μ -expansion, 75
- μ -notation, 44
- multiset, 28
 - difference, 28
 - inclusion, 28
 - union, 28
- must relation, 117
- mutual exclusion, 39, 49
- net, 26
 - abstract, 31
 - causal, 32, 33
 - cyclic, 27
 - finite, 61
 - place/transition, 26
 - safe, 30, 60
- nondeterminism, 24, 124
- normal form
 - of expressions, 104
- OCCAM, 227
- parallel composition
 - informal semantics, 47
 - interleaving semantics, 74
 - net semantics, 54, 89
 - readiness semantics, 141
 - rule, 177, 233
 - syntax, 45
- partial order, 136
 - complete, 137
 - for readiness semantics, 139
- Peano arithmetic, 111
- Petri net, 26
- place, 26
 - reachable, 29
- POOL, 227
- postset, 26
- prefix closure, 118
 - readiness semantics, 126
 - regular expressions, 112
 - specifications, 175
- prefix kernel, 175
- prefix operator
 - informal semantics, 47
 - interleaving semantics, 73
 - net semantics, 53, 89
 - readiness semantics, 140
 - rule, 177, 233
 - syntax, 45
- prefix relation, 101
- preset, 26
- priority, 45, 113

SUBJECT INDEX

259

- process, 1, 33
 - information, 125
- process term, 46
 - closed, 47
 - nested recursive, 224
 - regular, 62
- projection, 102
 - alphabet, 109
 - lemma, 109
 - operator, 99
- reachability problem, 65
- readiness
 - domain, 125
 - formula, 229
 - logic, 229
 - specification, 229
- readiness semantics
 - denotational, 142, 172
 - of mixed terms, 172
 - of nets, 125
 - of process terms, 126
 - of specifications, 134, 232
 - operational, 126
- ready, 116
 - pair, 125
 - set, 124
- recursion
 - denotational semantics, 139
 - informal semantics, 47
 - interleaving semantics, 74
 - net semantics, 52, 58
 - readiness semantics, 142
 - rule, 178, 234
 - syntax, 45
- recursively enumerable, 111
- regular
 - expression, 112
 - language, 221
 - process term, 62
- relation
 - image, 150
 - pre-image, 150
 - pre-image finite, 150
- renaming, 100
 - disjoint, 179, 234
- renaming operator
 - readiness semantics, 141
 - rule, 178, 233
 - syntax, 45, 99
- retrievability, 70
- retrievability principle, 70
- root unwinding, 90
- rule
 - algebraic, 174
 - construction, 174
 - equation, 174
 - implication, 232
 - specification, 174
 - transformation, 174
 - transition, 53, 73
- safeness, 60
- safety, 115, 230
- satisfaction relation
 - for process terms, 115, 230
 - for traces, 110
- scheduling problem, 208
- selection
 - of a communication, 99
- semantic domain, 136
 - for readiness semantics, 125
 - for trace logic, 101
- semantic equation, 173
- semantic implication, 173
- semantic operator, 138
- semantics
 - compositional, 50, 72, 89
 - denotational, 136, 138
 - event structure, 73
 - failure, 166
 - informal, 47
 - interleaving, 75
 - of trace logic, 102
 - operational, 50, 55, 75, 126
 - Petri net, 55
 - readiness, 125
 - step, 73
 - strong testing, 166
- semaphore, 48

- sequential components, 51
 - complete set of, 52
 - decomposition into, 51
- soundness, 174
 - theorem, 180
- specification, 110
 - rule, 177, 233
- stability, 116, 117
- state, 20
 - initial, 21
 - reachable, 22
- state chart, 20
- state transition diagram, 21
- step, 29
- stepwise refinement, 171
- stream, 237
- subdomain, 138
- substitution, 46, 100
- synchronisation, 57
 - set, 51
- synchrony, 54, 74
- TCSP, 44
- temporal logic, 98, 123
- term, 44
 - action-guarded, 46
 - closed, 46
 - communication-guarded, 175
 - mixed, 172
 - process, 46
 - recursive, 44
- theory
 - of trace specifications, 174
- token game, 28
- trace
 - expression, 100
 - formula, 100
 - infinite, 237
 - logic, 99
 - Mazurkiewicz-, 97
 - quiescent, 98
 - specification, 110
- trace*, 101
- transfer property, 23, 36
- transformation rule, 174
- transformational programming, 173
- transition, 21, 26
 - axiom, 53
 - enabled, 29
 - global, 28
 - labelled, 21, 26
 - rule, 53
 - system, 20
- transition relation, 26
 - interleaving, 73
 - Petri net, 53
- Turing powerful, 65
- UNITY, 227
- validity
 - of trace formulas, 103
- variable, 99
 - bound, 100
 - free, 100
 - negative occurrence, 230
 - positive occurrence, 230
- verification, 171
 - completeness, 220
- well-structured, 126
 - readiness domain, 149

SYMBOL INDEX

In this book various sets of syntactic and semantic objects are defined. For each set we introduce some typical elements ranging over this set. For example, we introduce re as a typical element of Reg , the set of regular expressions. In this symbol index we record this by writing $re \in Reg$. In applications these typical elements may be decorated by subscripts or dashes.

SETS AND MULTISSETS

$\{x \mid \dots\}$	set of all x such that “...” holds	22
\emptyset	empty set	32
\mathbb{N}_0	set of natural numbers	34
$x \in M$	element of M	21
$x \notin M$	not element of M	89
$M \subseteq N$	set and multiset inclusion	21, 28
$M \cup N$	set union	20
$M \sqcup N$	multiset union	28
$M \cap N$	set intersection	38
$M - N$	set and multiset difference	28
$M \times N$	Cartesian product	21
$\mathcal{P}(M)$	powerset of M	125
$\mathcal{P}_{nf}(M)$	powerset of non-empty finite subsets of M	26
$ M $	cardinality of M	32

FUNCTIONS

id_M	identity on M	93
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For a function $f : A \rightarrow B$ and a set $M \subseteq A$ we use the following notation:

$f(M)$	image of M under f	33
$f \downarrow M$	restriction of f to M	33

LANGUAGES

A^*	set of finite words over A	111, 221
\sim_L	right congruence of a language $L \subseteq A^*$	221
A^*/\sim_L	congruence classes of A^* under \sim_L	221
$re \in Reg$	regular expressions	112
$pref\ re$	prefix	113
$re_1 \cup re_2$	union	113
$re_1.re_2$	concatenation	113
re^*	Kleene star	113
$\mathcal{L}[re]$	language denoted by re	113

COMMUNICATIONS

$a, b, c \in Comm$	communications	20
$A, B \subseteq Comm$	alphabets	20
$tr \in Comm^*$	traces	101
$\varepsilon \in Comm^*$	empty trace	101
$tr_1.tr_2$	concatenation	101
$tr_1 \leq tr_2$	prefix relation	101
$u, v, w \in Act$	actions	20
$\tau \in Act$	internal action	20

AUTOMATA

$\mathcal{A} = (A, St, \longrightarrow, q_0)$	automaton	20
$p, q, r \in St$	states	20, 21
$q_0 \in St$	initial state	21
$p \xrightarrow{u} q$	transition	21
$reach(\mathcal{A})$	reachable states	22
$\mathcal{A}_1 =_{isom} \mathcal{A}_2$	weakly isomorphic	22
$[\mathcal{A}]$	abstract automaton	22
$AAut$	set of abstract automata	22
$\mathcal{A}_1 \approx \mathcal{A}_2$	strongly bisimilar	23
$\mathcal{B} \subseteq St_1 \times St_2$	strong bisimulation	23
$\mathcal{A}(\mathcal{N})$	interleaving case graph of a net	31
$P \xrightarrow{u} Q$	interleaving transition	73
$\mathcal{A}[P]$	operational interleaving semantics	75

SYMBOL INDEX

263

PETRI NETS

$\mathcal{N} = (A, Pl, \longrightarrow, M_0)$	Petri net	26
$p, q, r \in Pl$	places	26
M, N	markings	28
$M_0 \subseteq Pl$	initial marking	26
wf	well-formed (marking)	58
suf	strongly well-formed (marking)	78
$next(M)$	next actions	116
$upd(M)$	update operation	78
$t = I \xrightarrow{u} O$	net transition	26
$t \in \longrightarrow$	transitions	26
$\mathcal{T} \subseteq \longrightarrow$	global transitions	28
$pre(t), pre(\mathcal{T}), pre(p)$	preset	26, 28, 32
$act(t), act(\mathcal{T})$	action	26, 29
$post(t), post(\mathcal{T}), post(p)$	postset	26, 29, 32
$\mathcal{F}_{\mathcal{N}}$	flow relation	32
$M \xrightarrow{t} M'$	transition execution	29
$M \xrightarrow{\mathcal{T}} M'$	concurrent transition execution, step	29
$M \xrightarrow{tr} M'$	execution of a trace	116
$mark(\mathcal{N})$	reachable markings	29
$place(\mathcal{N})$	statically reachable place	29
$\mathcal{N}_1 =_{isom} \mathcal{N}_2$	weakly isomorphic	30
$[\mathcal{N}]$	abstract net	31
$ANet$	set of abstract nets	31
$\mathcal{N}_1 \equiv_{caus} \mathcal{N}_2$	causally equivalent	35
$\mathcal{B} \subseteq Pl_1 \times Pl_2$	strong bisimulation on places	36
$\hat{\mathcal{B}}$	lifting	35
$\mathcal{N}_1 \approx \mathcal{N}_2$	strongly bisimilar	36

PROCESS TERMS

$X, Y, Z \in Idf$	identifiers	44
$Idf: A$	identifiers of alphabet A	44
$\varphi: Act \longrightarrow Act$	action morphisms	44
$P, Q, R \in Rec$	recursive terms	44
$C(X) \in Rec$	context	160
$Proc \subseteq Rec$	process terms	47
$CProc$	closed process terms	47
$RegProc$	regular process terms	62
$stop:A$	deadlock	45
$div:A$	divergence	45
$a.P$	prefix operator	45

$P + Q$	choice operator	45
$P \parallel Q$	parallel composition	45
$P[\varphi]$	morphism	45
$\mu X.P$	recursion	45
$\sum_{i=1}^n P_i$	general choice	45
$\parallel_{i=1}^n P_i$	general parallelism	45
$P[b_1, \dots, b_n/a_1, \dots, a_n]$	renaming operator	45
$P \setminus B$	hiding operator	45
$free(P)$	free identifiers	46
$P\{Q/X\}$	substitution	46
$P\{Q_1, \dots, Q_n/X_1, \dots, X_n\}$	simultaneous substitution	46
$\alpha(P)$	alphabet	46
op_α	alphabet operators	47
$exp(P)$	μ -expansion	75
$dex(P)$	decomposition and expansion	51

NET SEMANTICS

$C, D \in Sequ$	sequential components	51
$\mathbb{P}, \mathbb{Q}, \mathbb{R} \subseteq Sequ$	sets of sequential components	51
$C \parallel_A \mathbb{P} \parallel_A$	left part of parallel decomposition	51
$\parallel_A D, \parallel_A \mathbb{Q}$	right part of parallel decomposition	51
$C + D, \mathbb{P} + \mathbb{Q}$	choice	51
$C[\varphi], \mathbb{P}[\varphi]$	morphism	51
$dex(P)$	decomposition and expansion	51
$\gamma(P), \gamma(\mathbb{P})$	syntactic complexity	52
$\alpha(\mathbb{P})$	alphabet	52
$\mathbb{P} \xrightarrow{u} \mathbb{Q}$	net transition	53
$\mathcal{N}[[P]]$	operational net semantics	55
$\longrightarrow \downarrow \alpha(P)$	transition relation restricted to $\alpha(P)$	55
$op_{\mathcal{N}}$	compositional net operators for	89
$stop: A_{\mathcal{N}}$	... deadlock	89
$div: A_{\mathcal{N}}$	... divergence	89
$a_{\mathcal{N}}[\mathcal{N}_0]$	... prefix	89
$[\mathcal{N}_1] +_{\mathcal{N}} [\mathcal{N}_2]$	... choice	89
$[\mathcal{N}_1] \parallel_{\mathcal{N}} [\mathcal{N}_2]$	... parallel composition	89
$[\mathcal{N}_0][\varphi]_{\mathcal{N}}$	... morphism	90

LOGICAL FORMULAS

$t, h \in Var : trace$	trace variables	99, 110
$G, H \in Var : set$	set variables	229
$n \in Var : nat$	natural number variables	99

SYMBOL INDEX

265

$xe \in Exp$	expressions	100
$xe\{te/t\}$	substitution	100
$xe\{te_1, \dots, te_n/t_1, \dots, t_n\}$	simultaneous substitution	100
$xe\{b/a\}$	renaming	100
$xe\{b_1, \dots, b_n/a_1, \dots, a_n\}$	simultaneous renaming	100
xe_{norm}	normal form	104
$\alpha_i(xe)$	(projection) alphabet	109
$\alpha\alpha(xe)$	extended alphabet	104
$te \in Exp : trace$	trace expressions	100
$te_1.te_2$	concatenation	100
$te \downarrow A$	projection operator	100
$te[b/a]$	renaming operator	100
$se \in Exp : set$	set expressions	229
$ne \in Exp : nat$	natural number expressions	100
$|te|$	length of te	100
$a\#te$	number of a 's in te	112
$ne_1 + ne_2$	addition	100
$ne_1 * ne_2$	multiplication	100
$ce \in Exp : comm$	communication expressions	100
$te[ne]$	ne -th element of te	100
$first\ te$	first element of te	112
$last\ te$	last element of te	112
$le \in Exp : log$	logical expressions, trace formulas	100
$te_1 \leq te_2$	prefix relation	100
$se_1 \subseteq se_2$	set inclusion	229
$\neg le$	negation	100
$le_1 \wedge le_2$	conjunction	100
$le_1 \vee le_2$	disjunction	112
$le_1 \longrightarrow le_2$	implication	112
$le_1 \longleftrightarrow le_2$	equivalence	112
$\exists t : le, \exists n : le$	existential quantification	100
$\forall t : le, \forall n : le$	universal quantification	112
$\exists t \in A^* : le$	relativised quantification	112
$\forall t \in A^* : le$	relativised quantification	112
$\bigvee_{j=1}^k le_j$	general conjunction	112
\mathfrak{S}	interpretation of trace logic	101
$\rho \in Env_{\mathfrak{S}}$	environments	102
$\rho[tr/t], \rho[k/n]$	update of environments	103
$\mathfrak{S}[[xe]](\rho)$	standard semantics of expressions	102, 103
\perp	special semantic value (<i>bottom</i>)	101
$\models le$	validity of trace formulas	103

TRACE SPECIFICATIONS AND MIXED TERMS

$S, T, U \in Spec$	trace specifications	110
$\alpha(S)$	(projection) alphabet	110
$\alpha\alpha(S)$	extended alphabet	110
$tr \models S$	satisfaction relation for traces	110
$pref\ tr \models S$	... and all their prefixes	116
$P\ sat\ S$	satisfaction relation for process terms	115
$kern(S)$	kernel	175
$init(S)$	initial communications	175
$Th(Spec)$	theory of trace specifications	174
$P, Q, R \in Proc + Spec$	mixed terms	172
$CProc + Spec$	closed mixed terms	172

READINESS SEMANTICS

\mathcal{R}	readiness semantics	124
\mathcal{R}^*	modified readiness semantics	124
$\gamma, \delta \in Info_{\mathcal{R}} : A$	process information	125
$\Gamma, \Delta \in Info_{\mathcal{R}} : A$	sets of process information	125
$(A, \Gamma), (B, \Delta) \in DOM_{\mathcal{R}}$	readiness domain	125
$ws-DOM_{\mathcal{R}}$	well-structured readiness domain	149
$\alpha(A, \Gamma)$	alphabet part	125
$\pi(A, \Gamma)$	process information part	125
$close(A, \Gamma)$	closure operator	126
$succ(tr, \Gamma)$	successor communications	126
$\mathcal{F}, \mathcal{G}, \mathcal{H}$	ready sets	125
$\mathcal{X} \subseteq Comm \cup \{\uparrow\}$	ready sets or divergence symbol	125
$\mathcal{R}^*(\mathcal{N})$	readiness semantics of nets	125
$\mathcal{R}^*[P]$	(operational) readiness semantics of process terms	126
$\mathcal{R}^*[S]$	readiness semantics of trace specifications	134
$x \sqsubseteq y$	partial order	136
\perp	least element (<i>bottom</i>)	138
$\sqcup D$	least upper bound	136
$\sqcup_{x>0} x_n$	limit of a chain	137
$fix\ \Phi$	fixed point of Φ	137
Φ^n	n -fold iteration of Φ	138
$\rho \in Env_{\mathcal{M}}$	environments	138
$\mathcal{R}^{**}[P](\rho)$	denotational readiness semantics of process terms	142
$op_{\mathcal{R}}$	readiness operators for	140
$stop:A_{\mathcal{R}}$	... deadlock	140
$div:A_{\mathcal{R}}$	... divergence	140

SYMBOL INDEX

267

$a.\mathcal{R}(A, \Gamma)$	... prefix	140
$(A, \Gamma) +_{\mathcal{R}} (B, \Delta)$	... choice	141
$(A, \Gamma) \parallel_{\mathcal{R}} (B, \Delta)$	... parallel composition	141
$(A, \Gamma)[b/a]_{\mathcal{R}}$	... renaming	141
$(A, \Gamma) \setminus b_{\mathcal{R}}$	... hiding	142
$P \equiv_{sat} Q$	satisfaction equivalence	160
$P \equiv_{\mathcal{M}} Q$	model equivalence	161
$P \equiv_{\mathcal{R}^*} Q$	modified readiness equivalence	167
$P \equiv_{\mathcal{F}} Q$	failure equivalence	167
$P \equiv_S Q$	strong testing equivalence	167
$P \equiv \Rightarrow Q$	semantic implication	173
$P \equiv Q$	semantic equation	173